

and harvestable oysters to cownose rays. In 1975, several Virginia oyster growers asked for aid in reducing ray predation. Evidence addressing the possibility of an increase in cownose ray populations seemed to exist at the time, based on literature by Hildebrand and Schroeder (1928) who noted them as rare in Chesapeake Bay and later by Musick (1972), who listed them as abundant to common in the Bay (Merriner and Smith 1979). Pound net gear and haul seines had also decreased in number resulting in reduced fishing mortality on rays and increased survival. It was also noted that the preferred food of the cownose ray is soft-shelled clam whose numbers may have plummeted in the Rappahannock River after Tropical Storm Agnes in June 1972 (Andrews 1973). The combination of reduced fishing mortality along with a decrease in its preferred food item may have caused a shift in predation toward oysters in the Rappahannock River (Merriner and Smith 1979).

Otwell and Lanier (1978) also described the rays as a nuisance to scallop fishermen in North Carolina because they uprooted eelgrass and fed on scallops. They tried to establish markets for cownose rays because of their high abundance, predation on bay scallops, and destruction of eelgrass beds in North Carolina. European markets were explored where there was an established market for various species of skates. Frozen wing samples of cownose rays from Core Sound were shipped to England and distributed to France, Sweden, Germany, and Italy but met with disappointing responses. Apparently, they were marketed as 'skate', which has a white flesh, compared to the cownose ray, which has a red bloody flesh. Taste tests and experimental harvesting of rays by long haul seines around Barden Inlet were conducted. Harvested rays were iced, processed (wings cut from the body and bled), packaged and frozen manually at the seafood house. It was concluded that there were potential foreign and domestic markets and that processors were willing to handle the product if there was enough profit to allow dealing through international brokers. However, further work was needed in their utilization technology (i.e., product quality, handling problems, etc.)

Peterson et al. (2001) and Powers and Gaskill (2005) suggest that cownose rays feed in areas where bay scallops occur in high densities (greater than 70 scallops/m<sup>2</sup>). Areas in Back Sound and the mouth of North River where high densities of scallops occur are reduced to 0.00 scallops/m<sup>2</sup> in a period of two to four weeks. This period of high mortality occurs during the summer before scallops spawn and has been detected in most years since the early 1990s (Peterson et al 2001; Powers and Gaskill 2005). Since this mortality occurs before the scallops spawn, these scallops do not contribute to the population the following year. The site-specific selection of grassbeds in these areas by large schools of rays may be related to a highly efficient feeding behavior as they migrate south resulting in a large number of scallops being lost to the fishery. Mortality occurs between August 15 and September 15 and corresponds with the southerly migration of cownose rays (Peterson et al. 2001; Powers and Gaskill 2005). Experiments where cownose rays were excluded from these areas of high bay scallop densities further demonstrated that rays are the cause of the high mortality that occurs at this time. Independent gill net survey data taken in Pamlico Sound by DMF also indicates increased number of rays during this time period (Figure 9.10). Bogue Sound, however, where scallop densities were lower than Core Sound, experienced lower mortality (Powers and